

PREVENTION THROUGH DESIGN: GUIDELINES FOR DESIGNERS

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ABSTRACT

The workplace of construction is considered complex with diversity of activities, teams, using machinery and equipment during the production process. Also particular aspects are inherent to the methods of production. If considering the multiple factors involved in construction and their high rates of accidents, it means that is crucial to implement preventive measures thought from the beginning of risks, during the project design.

Generally, literature presents the benefits of prevention through design, demonstrates the viability and makes projections for the future. In some countries, the legislation of responsibility for construction worker safety is also shared with the designer. However the existing material is still new, integrating safety considerations into the design process in practice is low and there are still many difficulties and associated resistances.

In this context, this paper aims to presentation an ongoing study, which its objective is contribute to filling this gap in order to directly assist the designers and contractors. The proposal is to produce a model for integrating safety considerations into the design process and a practical guide containing work safety guidelines for designers.

Keywords: Design, Prevention, Safety, Construction

1. INTRODUCTION

Worldwide occurrences of work accidents per year are approximately 270 million, of these accidents around two million result in deaths of men and women. Every year more than 160 million occupational diseases are reported and recorded. On average, every day 5,000 people die due to accidents or work-related diseases. In one third of these cases, the disease causes the loss of at least four working days. In addition, there is a 4% loss of gross domestic product (GDP) due to the costs of work absences, illnesses, treatments of disability, and pensions for surviving injuries, deaths and illnesses (ILO, 2010a).

Within the framework of the EU countries, EUROSTAT data indicates that all 5,720 people die each year as a result of accidents at work. The International Labor Organization estimates that an additional

159,500 workers die every year from occupational diseases in the EU. It is estimated that every three and a half minutes, someone dies from work-related causes (OSHA-EU, 2010).

The construction sector stands out with one in six fatalities occurrences. Per year, it is found at least 60,000 deaths at construction sites around the world, leading to an estimate of a deadly accident every ten minutes (ILO, 2010b).

The EU countries accounts for less than 2% of fatal occupational accidents at work places in the world. In WHO regions the statistics point out Asia and the Pacific region with 64% of the 60.000 fatal accidents at work, followed for Americas (17%), Africa (10%) and Europe (9%) (Dias, 2005).

In numbers, around 1,300 workers per year are victims of fatal accidents in construction sites in the EU. That is equivalent to 13 employees in each 100,000, i.e. more than twice the average of other sectors. According European Commission (2004) apud EU-OSHA (2009), the costs of accidents are of particular concern to small and medium-sized enterprises because SMEs account for 82% of all occupational injuries and 90% of all fatal accidents

The European Agency for Safety and Health at Work - EU/OSHA (2003) states that worldwide construction workers are three times more likely to suffer injuries than workers in other areas. This agency outlines that the functions that deal with high altitude, excavations and moving loads are the most dangerous at the construction sector.

In Portugal, the fatalities in construction are more frequent and severe compared to other sectors. Of 163 fatalities that occurred in 2007, 82 relate to construction. The following year, the proportion was 120 fatalities occurring, 59 relate to construction. Until October of 2009, 94 deaths, 47 relate to construction (ACT, 2010).

In Brazil it was found that from the 77.663 occupational accidents reported in 2008, 49.191 were related to the construction industry. Concern for the building sector is evident when one knows the number of tax regulations. Data from a national study, carried out by tax auditors at the Ministry of Labor and Employment – MTE, between 2003 and 2009, shows that 174.333 tax proceedings were held in the construction during this period, corresponding to 17% of the actions promoted by the institution in the area of safety and health at work (Revista Proteção, 2010)

An important piece of data provided by the former Institute for development and Inspection of working conditions - IDICT points out that, about two in three accidents are predetermined before the commencement of activities of the jobsite. In addition, European research projects in the works show that only about 20% of the costs of accidents are caused by errors during execution activities.

The European Foundation for the Improvement of Living and Working Conditions (1991), through a study conducted in 1991 says that 60% of fatalities are coming from decisions taken before the commencement of activities of the construction sites and could have been avoided with the adoption of appropriate measures at the design stage.

2. PREVENTION THROUGH DESIGN - PtD

The Prevention through Design – PtD is a relatively recent concept in order that the first research and publications dating back in the early 1990's. This work, has adopted the concept defined by the National Institute for Occupational Safety and Health – NIOSH (2010), in which the PtD is seen as the "Addressing occupational safety and health needs in the design process to prevent or minimize the work-related hazards and risks associated with the construction, manufacture, use, maintenance, and disposal of facilities, materials, and equipment."

Accident prevention through design was first suggested in the Accident Prevention Manual from the National Safety Council – NSC in 1955. However, further initiatives may be cited. Research undertaken in the 1990's, funded by the Construction Industry Institute-CII in the United States, culminated in the production of a computational tool for designers.

Currently, several countries like the United States, Australia and European Union countries are engaged in studies on the prevention of accidents through the design, with groups of specific jobs to use as examples.

In the US, many owners of construction companies have had major safety concerns in their projects, starting from contractual decisions when they hire companies who are most committed to safety. The responsibility for safety in the workplace is first placed to the employer, - usually the general contractor - many companies fail from security procedures in the light of the high costs arising from occupational accidents (Gambatese and Hinze, 1999). Thus, many business owners encourage designers to incorporate safety at work on their designs. Some designers, especially those of design and construction companies, already include safety in their designs.

In Australia, the Australian Safety and Compensation Council - ASCC is the largest organ responsible for OSH Regulations Act, which replaced the NOSHC in October 2005. It is a tripartite body which emanates consultative guidelines for voluntary compliance integrated by the laws of each jurisdiction, i.e. for each State of the Commonwealth, - called the Australian Central Government.

In 2002, States, territories and the Commonwealth Ministers, leaders of the Australian Chamber of Commerce and Industry and the Australian Council of Trade Unions signed a 10 year national strategy for safety at work. The national strategy establishes two goals to achieve by June 30, 2012: reduce fatalities by at least 20% and reduce the incidence of injuries at least 40% (Creaser, 2008).

In addition, the national strategy identifies five national priorities (National OHS Strategy 2002-2010, 2010):

- Reduce the high incidence of risks;
- Improve the ability of company employees to manage OSH effectively;
- Prevent occupational diseases more effectively;
- Eliminate risks at the design stage;
- Strengthen the government's ability to influence the results of safety at work.

One of the studies databases to establish the elimination of risks in the design phase as the fourth priority refers to the investigation of accidents occurring between July 2000 and June 2002 in Australia, they were verified aspects related design (Driscoll et al., 2008).

In the EU, the duty to implement safety was the responsibility of the contractor as the performer of the work, but the legislation has changed this situation and implementation of prevention measures is not dependent on the contractor's only, but also the owner and designers. This integration is justified by taxes effectiveness, by decisions of preventive measures is taken at design level, and for coordination activity, depending on the activity of the coordination of safety at the design stage is also a design, which must be coordinated with the other specialties of the design (Soeiro, 2009).

In the United Kingdom, the transposition of European Directive 92/57/EEC of June 24, 1992, through Construction Design Management Regulations 2007 – CDM 2007 required that designers consider aspects of occupational safety in all phases of the construction, and it will be subject to litigation, fines and imprisonment.

The CDM emphasizes the identification and assessment of risks, and determines the required steps for the integration of safety at work in the design, involving the designer directly. However, it also introduces guidelines that are limited in how the risk assessment shall be carried out. That causes many designers, who do not have training or experience, to feel uncomfortable or threatened.

The Health and Safety Executive - HSE, the Government agency responsible for the prevention of accidents and occupational diseases in the United Kingdom, created the Safety in Design – SID, an entity that seeks to share ideas, suggest choices, educate and inform concerned professionals about their performance and duties (CDM, 2010).

In Brazil, one of the legislation specific to the construction sector, component of Safety Legislation and Occupational Medicine, is the Regulatory Norm nº 18 - Conditions and working environment in the construction industry. It establishes administrative guidelines, planning and organization, objective implementation of control measures and preventive safety systems in the process, under the conditions and working environment in the construction industry. Norm nº 18 sub item 3 requires the elaboration and implementation of the Program of conditions and working environment – PCMAT, for all establishments with 20 or more employees (Brazil, 2010).

However, the implementation of the program is restricted to the prevention of accidents during the executive phase of the project; there isn't a legal gap for the application of safety at work in the planning phase.

3. DESIGN MANAGEMENT AND SAFETY AT WORK

The designer has been identified as a construction worker holding great impact on safety at work. Historically, although designers do not take into account the safety in designs and often are not aware of the impacts of their decisions design in the safety of construction.

The development of design is an activity of increasing complexity. It surpasses the technical concepts as commonly used and requires an overview of the various businesses involved and other aspects of activity. Therefore, the quality of design depends not only on the designer, but also on an increasingly technical intervention on the part of the owner. This ensures the monitoring and verification of how the different phases of design are being carried out, seeking to introduce other important valences. (Couto and Teixeira, 2006).

Design management provides support to the owner in technical issues during the design stage and presents the potential for addressing occupational safety considerations throughout the design process.

According to Melhado et al., (2005), design management comprises all the activities involved in planning, organizing, directing and controlling the design process. This involves strategic nature tasks such as studies on demand or market, land surveying, attracting investments or financing sources of production, defining characteristics of the product to be built, in addition to tasks linked directly to the formation of design teams on each project.

The same authors distinguish design management to design coordination, featuring management as an activity linked to the development of generic procedures and coordination activity specifically linked to implementation in a given undertaking. They define the design coordinator as the principal agent in the management of the design process and have their principal tasks as performing actions of integration between designers; coordinating and controlling designs and exchanges of information in order to ensure that the design process meets deadlines and objectives.

The decree No. 701-H/2008 of July 29 2008 sets the design coordinator as the technician responsible for satisfying the requirements to be the designer, the articulation of the design team on the nature of the work, ensuring the participation of the designers; compatibility between the various designs as required; and compliance with laws and regulations applicable to each specialty.

For Oliveira (2004), there are three basic models of design coordination:

- Architecture firm holding the design coordination;
- The Construction Company assumes the responsibility for coordinating the development of designs;
- A Company that specializes is outsourced to exercise the design coordination.

In the European Union, there is also the coordinator for safety and health in design phase, defined as the natural or legal person, who performs during the preparation of the design, the tasks of coordination in the field of occupational safety and health, provided for in applicable legislation, and may also participate in the preparation of the contract negotiation process and other preparatory acts of construction works, concerning safety and health at work (Portugal, 2010).

Design coordination is a multi-disciplinary character activity, which involves various actions like consistency between designs, distribution of tasks, the definition and imposition of deadlines, organization of meetings, the organization and control of information flow, the definition of the technical solutions presented by team design, among others.

In view of the management of deadlines and products, the use of computational tools and models feature advantages in design management, such as optimization of a process integration team, a timeline view of overall process planning, consistency between designs, planning team meetings, etc.

In the field of occupational safety, design solutions already exist for most problems, but the challenge is to make changes to ensure that risks and hazards can be eliminated and/or minimized at source (Creaser, 2008). Don't just point out what to do; you need to show how to do, i.e. define methods for the viability of the insertion of the safety considerations in the planning stage. Many designers fail to show how their designs can ensure the safety of future workers. In addition there are too few tools and materials available for queries in order to assist them in recognition of risks and the adequacy of their designs.

4. STUDY IN PROGRESS

To understand the functioning of safety at the design stage, some questions are required, such as: what are the tasks in each design? How would the workflow design? How would the management of the flow?

Other issues may also be raised: Does the few existing manuals and computational tools in support of the originator apply to any region? Should there be an adaptation to the conditions of cultural, social and economic individuals to each location? Is it from the analysis of the causes of accidents at work, according to official data, that we can detect relationships with the design?

With the intention of answering some of these issues and in order to assist designers and constructors directly, a study should be started which aims at producing a model for the integration of safety at work in the design process, as well as a practical guide for designers containing guidelines for safety at work. This will be based on the development of a risk assessment method for the design phase.

The model aims to contribute in the prevention of risks of accidents in construction during the lifetime of the project (planning, implementation, maintenance and deconstruction), taking into consideration design decisions, as well as the risks and control measures.

The study consists of the following steps:

- Identification of key stakeholders (owner, co-ordinator, designers, etc.) and their respective powers under safety at work in construction, specifically in the sub-sector of buildings;
- Knowledge of the design process, as well as identifying implementation activities involved in each step;
- Survey of accident risks identified in implementation activities and related control measures;
- Search for statistics on occupational accidents that have occurred in recent years in the construction sector, in order to understand the underlying causes and support material to be developed;
- Review of case studies and fatalities as subject, in order to establish the possible links between the causes of the accident and the design decisions;
- Search and knowledge of risk assessment methods;
- Proposal of a method to assess risks at the design stage;
- Preparing a model for the integration of safety at work in designs;
- Drafting guide for designer containing guidelines for safety at work.

5. FINAL CONSIDERATIONS

Literature in general presents the benefits of preventing accidents through design, show project viability, and makes projections for the future. Furthermore, in some countries the legal responsibility of safety in the workplace is also shared with the designer.

However, the existing material available to the designer is still lacking. Considerations of safety at work in practice are insufficiently and there are still many difficulties and associated resistance.

In order to prevention through design works, it is necessary transformations in the attitude of project stakeholders, moved by awareness instead of law force. The safety at work is a responsibility of all society, and designers are holders of expertise. They have at their hands a great potential to promote safety thorough their designs.

Therefore, the challenge is to create a joint effort by educational institutions, businesses and professional borders and research groups in order to incorporate this new tool for the safety and health at work.

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